

being automated are the simple, repetitive ones. The growing use of automation, however, should increase demand for welding machine operators. Welders working on construction projects or in equipment repair will not be as affected, because their jobs are not as easily automated.

Technology is helping to improve welding and create more uses for welding in the workplace. For example, new ways are being developed to weld dissimilar materials and nonmetallic materials, such as plastics, composites, and new alloys. Also, laser beam welding and other techniques are improving the results of welding and making it applicable to a wider assortment of jobs. The effect of technological innovation on the overall use of welding is unclear, however, because other processes designed to replace welding and make welders more productive, such as new adhesive technologies and high-speed machining, will contribute to decreasing demand for these workers.

Earnings

Median annual earnings of welders and cutters were \$25,810 in 1998. The middle 50 percent earned between \$21,440 and \$32,020. The lowest 10 percent had earnings of less than \$17,550, while the top 10 percent earned over \$39,650. Median annual earnings in the industries employing the largest number of welders and cutters in 1997 were:

Ship and boat building and repairing	\$27,200
Construction and related machinery	25,300
Motor vehicles and equipment	24,700
Fabricated structural metal products	23,800
Miscellaneous repair shops	22,600

Median annual earnings of welding machine operators were \$25,010 in 1998. The middle 50 percent earned between \$20,820 and \$31,270. The lowest 10 percent had earnings of less than \$16,870, while the top 10 percent earned over \$39,710. Median annual earn-

ings in the industries employing the largest number of welding machine operators in 1997 were:

Construction and related machinery	\$26,100
Metal forgings and stampings	24,100
Motor vehicles and equipment	23,700
Fabricated structural metal products	22,400
Miscellaneous fabricated metal products	20,500

More than one-fourth of welders belong to unions. Among these are the International Association of Machinists and Aerospace Workers; the International Brotherhood of Boilermakers, Iron Ship Builders, Blacksmiths, Forgers and Helpers; the International Union, United Automobile, Aerospace and Agricultural Implement Workers of America; the United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry of the United States and Canada; and the United Electrical, Radio, and Machine Workers of America.

Related Occupations

Welders and cutters are skilled metal workers. Other metal workers include blacksmiths, forge shop workers, machinists, machine-tool operators, tool and die makers, millwrights, sheet-metal workers, boiler-makers, and metal sculptors.

Welding machine operators run machines that weld metal parts. Others who run metalworking machines include lathe and turning, milling and planing, punching and stamping press, and rolling machine operators.

Sources of Additional Information

For information on training opportunities and jobs for welders, cutters, and welding machine operators, contact local employers, the local office of the State employment service, or schools providing welding training.

Information on careers in welding is available from:

✦ American Welding Society, 550 N.W. Lejeune Rd., Miami, FL 33126-5699. Internet: <http://www.aws.org>

Plant and Systems Operators

Electric Power Generating Plant Operators and Power Distributors and Dispatchers

(O*NET 95021, 95023, 95026, and 95028)

Significant Points

- Overall employment of operators, distributors, and dispatchers is expected to decline, as deregulation and increasing competition cause the electric utility industry to restructure and cut jobs.
- Job losses will not be offset by new power plants because their greater automation requires fewer operators, and plant construction is expected to slow due to concerns about electric power generating overcapacity.
- Shrinking employment and low turnover of operator positions will decrease advancement opportunities for helpers and laborers.

Nature of the Work

Electricity is vital for most of our everyday activities. From the moment you flip the first switch each morning, you are connecting to a huge network of people, electric lines, and generating equipment. Electric power generating plant operators control the machinery that generates electricity. Power distributors and dispatchers control the

flow of electricity, from the power plant over a network of transmission lines to industrial plants and substations, and finally over distribution lines to residential users.

Electric power generating plant operators control and monitor boilers, turbines, generators, and auxiliary equipment in power generating plants. Operators distribute power demands among generators, combine the current from several generators, and monitor instruments to maintain voltage and regulate electricity flows from the plant. When power requirements change, these workers start or stop generators and connect or disconnect them from circuits. They may use computers to keep records of switching operations and loads on generators, lines, and transformers. Operators may also use computers to prepare reports of unusual incidents, malfunctioning equipment, or maintenance performed during their shift.

Operators in plants with automated control systems work mainly in a central control room and usually are called *control room operators* and *control room operator trainees* or *assistants*. In older plants, the controls for the equipment are not centralized, and *switchboard operators* control the flow of electricity from a central point, whereas *auxiliary equipment operators* work throughout the plant, operating and monitoring valves, switches, and gauges.

The Nuclear Regulatory Commission (NRC) licenses operators of nuclear power plants. *Reactor operators* are authorized to control equipment that affects the power of the reactor in a nuclear power plant. In addition, an NRC-licensed *senior reactor operator* acts as the supervisor of the plant for each shift and supervises operation of all controls in the control room.

Power distributors and dispatchers, also called *load dispatchers* or *systems operators*, control the flow of electricity through transmission lines to industrial plants and substations that supply residential electric

needs. They operate current converters, voltage transformers, and circuit breakers. Dispatchers monitor equipment and record readings at a pilot board, which is a map of the transmission grid system showing the status of transmission circuits and connections with substations and industrial plants.

Dispatchers also anticipate power needs, such as those caused by changes in the weather. They call control room operators to start or stop boilers and generators, to bring production into balance with needs. They handle emergencies such as transformer or transmission line failures and route current around affected areas. They also operate and monitor equipment in substations, which step up or step down voltage, and operate switchboard levers to control the flow of electricity in and out of substations.

Working Conditions

Because electricity is provided around the clock, operators, distributors, and dispatchers usually work one of three daily 8-hour shifts or one of two 12-hour shifts on a rotating basis. Shift assignments may change periodically, so all operators can share duty on less desirable shifts. Work on rotating shifts can be stressful and fatiguing, because of the constant change in living and sleeping patterns. Operators, distributors, and dispatchers who work in control rooms generally sit or stand at a control station. This work is not physically strenuous but requires constant attention. Operators who work outside the control room may be exposed to danger from electric shock, falls, and burns.



Plant operators often use computers to keep records of switching operations and loads on generators, lines, and transformers.

Nuclear power plant operators are subject to random drug and alcohol tests, as are most workers at nuclear power plants.

Employment

Electric power generating plant operators and power distributors and dispatchers held about 45,000 jobs in 1998. Jobs are located throughout the country. About 92 percent worked for utility companies and government agencies that produced electricity. Others worked for manufacturing establishments that produce electricity for their own use.

Training, Other Qualifications, and Advancement

Employers seek high school graduates for entry level operator, distributor, and dispatcher positions. They prefer candidates with strong math and science skills. College level courses or prior experience in a mechanical or technical job may be helpful. Employers increasingly require computer proficiency, as computers are used to keep records, generate reports, and track maintenance. Most entry-level positions are helper or laborer jobs, such as powerline construction. Depending on the results of aptitude tests, worker preferences, and availability of openings, workers may be assigned to train for one of many utility positions.

Workers selected for training as a power distributor or power plant operator at a fossil-fueled power plant undergo extensive on-the-job and classroom training. Several years of training and experience are required to become a fully qualified control room operator or power distributor. With further training and experience, workers may advance to shift supervisor. Utilities generally promote from within; therefore, opportunities to advance by moving to another employer are limited.

Extensive training and experience are necessary to pass the Nuclear Regulatory Commission (NRC) examinations for licensed reactor operators and senior reactor operators. To maintain their license, licensed reactor operators must pass an annual practical plant operation exam and a biennial written exam administered by their employer. Training may include simulator and on-the-job training, classroom instruction, and individual study. Entrants to nuclear power plant operator trainee jobs must have strong math and science skills. Experience in other power plants or with Navy nuclear propulsion plants also is helpful. With further training and experience, reactor operators may advance to senior reactor operators.

In addition to preliminary training as a power plant operator or power distributor or dispatcher, most workers are given periodic refresher training. Nuclear power plant operators are given frequent refresher training. This training is usually taken on plant simulators designed specifically to replicate procedures and situations that might be encountered working at the trainee's plant.

Job Outlook

People who want to become electric power generating plant operators and power distributors and dispatchers are expected to encounter keen competition for these high-paying jobs. Declining employment and low turnover in this occupation will result in few job opportunities for the large number of eligible candidates.

Employment of electric power generating plant operators and power distributors and dispatchers is expected to decline slightly through the year 2008, as the industry restructures in response to deregulation and increasing competition. The Energy Policy Act of 1992 has had a tremendous impact on the organization of the utilities industry. This legislation enabled increased competition in power generating utilities, by allowing independent power producers to sell power directly to industrial and other wholesale customers. Utilities, historically operated as regulated local monopolies, are restructuring operations to reduce costs and compete effectively, resulting in fewer jobs at all levels and reduced job security.

The pace of new plant construction and equipment upgrading will also limit opportunities for electric power generating plant operators, distributors, and dispatchers. Expansion of power-generating capacity is expected to gradually slow through the year 2008, as utilities strive to avoid

overcapacity. In addition, the increasing use of automatic controls and more efficient equipment in new plants should require fewer operators.

Earnings

Median annual earnings of power generating and reactor plant operators were \$44,840 in 1998. The middle 50 percent earned between \$37,190 and \$50,940 a year. The lowest 10 percent earned less than \$29,000 and the highest 10 percent earned more than \$73,090 a year. Median annual earnings of power generating plant operators in 1997 were \$43,800 in electric services.

Median annual earnings of power distributors and dispatchers were \$45,690 in 1998. The middle 50 percent earned between \$37,350 and \$56,810 a year. The lowest 10 percent earned less than \$29,620 and the highest 10 percent earned more than \$78,060 a year.

According to information from union surveys, average annual earnings for fossil fuel power plant operators were about \$46,500 in 1999. Nuclear power plant operators earned an average of about \$56,200 annually in 1998. Senior or chief operators earned 10 to 15 percent more than operators did. Over half of all electric power generating plant operators and power distributors and dispatchers were union members.

Related Occupations

Other workers who monitor and operate plant and systems equipment include stationary engineers, water and wastewater treatment plant operators, waterworks pumpstation operators, chemical plant and system operators, and refinery operators.

Sources of Additional Information

For information about employment opportunities, contact local electric utility companies, locals of unions mentioned below, and an office of the State employment service.

For general information about power plant and nuclear reactor operators and power distributors and dispatchers, contact:

- ☛ International Brotherhood of Electrical Workers, 1125 15th St. NW., Washington, DC 20005.
- ☛ Utility Workers Union of America, 815 16th St. NW., Washington, DC 20006.

Stationary Engineers

(O*NET 95032)

Significant Points

- Job opportunities will be best for workers with computer training.
- Stationary engineers usually acquire their skills through a formal apprenticeship program or informal on-the-job training supplemented by courses at a trade or technical school.
- A license to operate boilers, ventilation, air conditioning, and other equipment is required in most States and cities.

Nature of the Work

Heating, air-conditioning, and ventilation systems keep large buildings comfortable all year long. Industrial plants often have facilities to provide electrical power, steam, or other services. Stationary engineers operate and maintain these systems, which can include boilers, air-conditioning and refrigeration equipment, diesel engines, turbines, generators, pumps, condensers, and compressors. The equipment stationary engineers operate is similar to equipment operated by locomotive or marine engineers, except it is not on a moving vehicle.

Stationary engineers start up, regulate, and shut down equipment. They ensure that it operates safely, economically, and within established

limits by monitoring meters, gauges, and computerized controls. They manually control equipment and, if necessary, make adjustments. They use hand and power tools to perform repairs and maintenance ranging from a complete overhaul to replacing defective valves, gaskets, or bearings. They also record relevant events and facts concerning operation and maintenance in an equipment log. On steam boilers, for example, they observe, control, and record steam pressure, temperature, water level and chemistry, power output, fuel consumption, and emissions. They watch and listen to machinery and routinely check safety devices, identifying and correcting any trouble that develops.

Increasingly, stationary engineers use computers to operate the mechanical systems of new buildings and plants. Engineers monitor, adjust, and diagnose these systems from a central location or from a laptop computer linked into the buildings' communications network.

Routine maintenance, such as lubricating moving parts, replacing filters, and removing soot and corrosion that can reduce operating efficiency, is a regular part of the work of stationary engineers. They test boiler water and add chemicals to prevent corrosion and harmful deposits. They also may check the air quality of the ventilation system and make adjustments to keep within mandated guidelines.

In a large building or industrial plant, a stationary engineer may be in charge of all mechanical systems in the building. Engineers may supervise the work of assistant stationary engineers, turbine operators, boiler tenders, and air-conditioning and refrigeration operators and mechanics. Some perform other maintenance duties, such as carpentry, plumbing, and electrical repairs. In a small building or industrial plant, there may be only one stationary engineer.



Stationary engineers increasingly use computers to operate the mechanical systems of new buildings and plants.